CLAIMS

What is claimed is:

1. A hybrid battery power source for implantable medical use, comprising:

a primary battery;

a secondary battery connected to receive power from said primary battery;

said secondary battery being adapted to power to an implantable medical device designed for high energy electrical stimulation of body tissue for therapeutic purposes; and

a charge rate control circuit powered by said primary battery for monitoring the state of charge of said secondary battery and using said state of charge to controlling the rate of charge of said secondary battery.

2. A hybrid battery power source in accordance with Claim 1 wherein said charge rate control circuit is adapted to measure changes in said state of charge and to produce a corresponding charge control output.

3. A hybrid battery power source in accordance with Claim 2 wherein said charge rate control circuit is adapted to change the rate of charge of said secondary battery in proportion to corresponding changes in said state of charge.

4. A hybrid battery power source in accordance with Claim 1 wherein said charge rate control circuit includes a microprocessor system adapted to change the rate of charge of said secondary battery according to logic that sets a charge rate according a state-of-charge history of said secondary battery.

5. A hybrid battery power source in accordance with Claim 4 wherein said microprocessor system is further adapted to calculate and provide voltage references for use by a charge control circuit powered by said primary battery that includes window comparator means for comparing the voltage of said secondary battery against said voltage references in order to charge said secondary battery while limiting charge/discharge excursions thereof in a manner that optimizes its output for high energy medical device use.

6. A hybrid battery power source in accordance with Claim 1 wherein said primary battery is selected from the group consisting of lithium-carbon monofluoride batteries, lithium-bromine chloride batteries, lithium-sulfuryl chloride batteries, lithium thionyl chloride batteries, lithium-manganese dioxide batteries, lithium-silver vanadium oxide batteries and lithium-iodide batteries, and wherein said secondary battery is selected from the group consisting of lithium-ion batteries.

7. A hybrid battery power source in accordance with Claim 1 further including a voltage boost circuit that facilitates charging of said secondary battery at a voltage that is higher than a voltage output of said primary battery.

8. A hybrid battery power source in accordance with Claim 7 wherein said voltage boost circuit comprises one of an inductive element or flyback transformer.

9. A hybrid battery power source in accordance with Claim 7 wherein said voltage boost circuit comprises a capacitive charge storage device.

10. A hybrid battery power source in accordance with Claim 9 wherein said voltage boost circuit is adapted to produce charging pulses of sufficiently short duration to reduce the discharge rate of said primary battery to a level that is compatible with the maximum discharge current capacity thereof.

11. An implantable medical device for high energy electrical stimulation of body tissue for therapeutic purposes, comprising:

a pair of electrical contacts adapted to provide electrical stimulation to body tissue;

energy storage means adapted to provide electrical energy to said electrical contacts;

switching means adapted to periodically interconnect said energy storage means to said electrical contacts; and

a hybrid battery power source adapted to provide power to said energy storage means and including:

a primary battery;

a secondary battery connected to receive power from said primary battery and to provide power to said energy storage means; and

a charge rate control circuit powered by said primary battery for monitoring the state of charge of said secondary battery and using said state of charge to controlling the rate of charge of said secondary battery.

12. An implantable medical device in accordance with Claim 11 wherein said charge rate control circuit is adapted to measure changes in said state of charge and to produce a corresponding charge control output.

13. An implantable medical device in accordance with Claim 11 wherein said charge rate control circuit is adapted to change the rate of charge of said secondary battery in proportion to corresponding changes in said state of charge.

14. An implantable medical device in accordance with Claim 11 wherein said charge rate control circuit includes a microprocessor system adapted to change the rate of charge of said secondary battery according to logic that sets a charge rate according a state-of-charge history of said secondary battery.

15. An implantable medical device in accordance with Claim 14 wherein said microprocessor system is further adapted to calculate and provide voltage references for use by a charge control circuit powered by said primary battery that includes window comparator means for comparing the voltage of said secondary battery against said voltage references in order to charge said secondary battery while limiting charge/discharge excursions thereof in a manner that optimizes its output for high energy medical device use.

16. An implantable medical device in accordance with Claim 11 wherein said primary battery is selected from the group consisting of lithium-carbon monofluoride batteries, lithium-bromine chloride batteries, lithium-sulfuryl chloride batteries, lithium thionyl chloride batteries, lithium-manganese dioxide batteries, lithium-silver vanadium oxide batteries and lithium-iodide batteries, and wherein said secondary battery is selected from the group consisting of lithium-ion batteries.

17. An implantable medical device in accordance with Claim 11 further including a voltage boost circuit that facilitates charging of said secondary battery at a voltage that is higher than a voltage output of said primary battery.

18. An implantable medical device in accordance with Claim 17 wherein said voltage boost circuit comprises one of an inductive element or flyback transformer.

19. An implantable medical device in accordance with Claim 17 wherein said voltage boost circuit comprises a capacitive charge storage device.

20. An implantable medical device in accordance with Claim 19 wherein said voltage boost circuit is adapted to produce charging pulses of sufficiently short duration to reduce the discharge rate of said primary battery to a level that is compatible with the maximum discharge current capacity thereof.

21. A method for powering an implantable medical device designed for high energy electrical stimulation of body tissue for therapeutic purposes, comprising:

providing a primary battery;

providing a secondary battery and connecting it to receive power from said primary power battery;

connecting said secondary battery to power said implantable medical device;

periodically monitoring the charge state of said secondary battery; and

using said state of charge to control the rate of charge of said secondary battery.

22. A method in accordance with Claim 21 wherein said controlling includes measuring changes in said state of charge to produce a corresponding charge control output.

23. A method in accordance with Claim 21 wherein said controlling includes changing the rate of charge of said secondary battery in proportion to corresponding changes in said state of charge.

24. A method in accordance with Claim 21 wherein said controlling includes using a microprocessor system adapted to change the rate of charge of said secondary battery according to logic that sets a charge rate according a state-of-charge history of said secondary battery.

25. A method in accordance with Claim 24 wherein said microprocessor system is further used to calculate and provide voltage references that are compared against the voltage of said secondary battery in order to charge said secondary battery while limiting charge/discharge excursions thereof in a manner that optimizes its output for high energy medical device use.

26. A method in accordance with Claim 21 wherein said primary battery is selected from the group consisting of lithium-carbon monofluoride batteries, lithium-bromine chloride batteries, lithium-sulfuryl chloride batteries, lithium thionyl chloride batteries, lithium-manganese dioxide batteries, lithium-silver vanadium oxide batteries and lithium-iodide batteries, and wherein said secondary battery is selected from the group consisting of lithium-ion batteries.

27. A method in accordance with Claim 21 further including voltage boosting in order to charge said secondary battery at a voltage that is higher than a voltage output of said primary battery.

28. A method in accordance with Claim 27 wherein said voltage boosting comprises inductive voltage boosting.

29. A method in accordance with Claim 27 wherein said voltage boosting comprises capacitive voltage boosting.

30. A method in accordance with Claim 29 wherein said voltage boosting comprises producing charging pulses of sufficiently short duration to reduce the discharge rate of said primary battery to a level that is compatible with the maximum discharge current capacity thereof.